THOMSON
DELMAR LEARNING

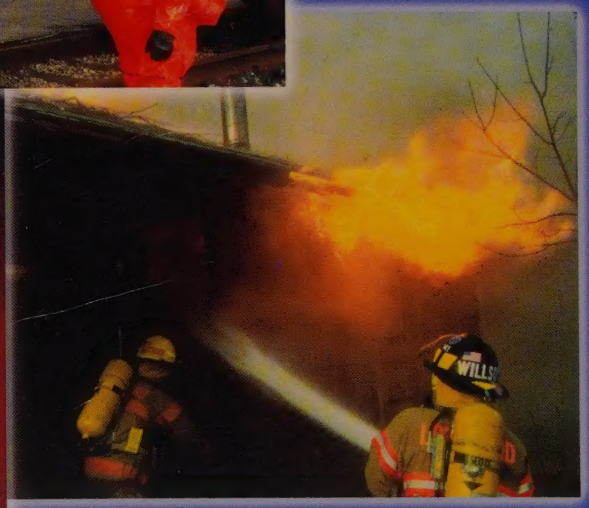
FIREFIGHTER'S HANDBOOK

Essentials of Firefighting and Emergency Response

Addendum

NEW YORK

Edition



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NEW YORK STATE

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Essentials of Firefighting and Emergency Response

Addendum

NEW YORK EDITION

THOMSON
DELMAR LEARNING™

Australia Canada Mexico Singapore Spain United Kingdom United States

THOMSON
DELMAR LEARNING

Firefighter's Handbook
Essentials of Firefighting and Emergency Response
Addendum
New York Edition

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WELCOME TO THE NEW YORK STATE FIRE TRAINING PROGRAM FIREFIGHTER TRAINING SERIES.

The Department of State recognizes that providing training for paid and volunteer firefighters and related officials is an important part of the services it makes available. Our Office of Fire Prevention and Control (OFPC) places a very high priority on training because we believe it is essential for the men and women of the fire and emergency services in New York State.

The Office of Fire Prevention and Control's programs include the most complete progression of training available today— beginning with probationary firefighters and extending the full length of a firefighter's career with the fire service. While our training programs address specific fire and arson prevention and control issues, we also encourage expansion and improvement of local training facilities and programs in cooperation with fire companies, municipal corporations and districts.

Students attending courses in the Firefighter Training Series begin their careers with tools learned in these fire service basic courses. This unique series is divided into three courses.

"Scene Support Operations" is designed to fill a need in the fire service to afford individuals not qualified to perform interior operations or prepared to commit to the rigors of the Firefighter I curriculum to participate in the fire service. Non-SCBA qualified exterior responders will be committed to exterior operations only and will not work in the hazardous materials incident warm or hot zone operations, interior structure fire, roof and/or ventilation operations or any other situation that will require them to wear respiratory protection.

"Firefighter I" is designed for the combat ready firefighter. Taken from the Delmar 2nd Edition and other OFPC courses, this is the foundational knowledge, skills, and abilities of an interior structural firefighter. This course will be a comprehensive course preparing the new probationary firefighter for interior structural operations and to meet the objectives of NFPA 1001 Firefighter I.

"Firefighter II" is designed with a team approach in mind. Taken from Delmar 2nd Edition this course is designed provide the Firefighter I with more advanced knowledge, skills, and abilities as well as help him/ her grow to become a company/ team leader. This course meets the NFPA 1001 Firefighter II objectives.

Your comments and suggestions about this student manual, our training classes or any OFPC program are always welcome. Your input will help us build on our successes and make needed changes, when appropriate.

On behalf of the citizens you serve, we want you to know that your participation and commitment are greatly appreciated.

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The Fire Administrator has appointed the following individuals to the committee created to develop an all inclusive program. This program includes Scene Support Operations, Firefighter I and Firefighter II programs.

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The committee would like to thank all of the instructors, coordinators and staff from Dutchess and Erie Counties for their time and talents devoted to the creation of this program during the pilot stages. Their valuable input was essential to the development process.

SECTION I

NATIONAL INCIDENT MANAGEMENT SYSTEM

OUTLINE

- Introduction
- Governors Executive Order
- Homeland Security Presidential Directive HSPD-5
- Evolution of ICS
- Student Requirement

INTRODUCTION

The need for a single Incident Management System, along with the growing need for a multi-agency and multi-functional involvement on incidents, has increased the need for a system that all emergency services can use in working towards similar goals.

Incident Management provides an important model for which all state, county, and local agencies may work together. The challenge is to get all the different agencies to work together in the most effective and efficient manner.

The principles of the Incident Management System will enable all agencies involved to use the same terminology, command structure, personnel accountability, resource management, unified command, and incident action plans.

GOVERNORS EXECUTIVE ORDER

On March 5, 1996, Governor Pataki signed Executive Order No. 26, establishing the National Interagency Incident Management – Incident Management Command System as the state standard command and control system that sets forth standardized procedures for managing personnel, communications, facilities, and resources.

HOMELAND SECURITY PRESIDENTIAL DIRECTIVE/HSPD-5

The purpose of this directive is to enhance the ability of the United States to manage domestic incidents by establishing a single, comprehensive national incident management system.

The national government wants to help prevent, prepare for, respond to, and recover from terrorist attacks, major disasters, and other emergencies. The United States Government shall establish a single, comprehensive approach to domestic management.

EVOLUTION OF ICS

The ICS system resulted from a need by the National Wildlife community for a new approach for managing rapidly growing wildfires in the early 1970s. Emergency managers faced a number of problems such as resource management, personnel accountability, lack of structure, consistent terminology, inadequate communications, and unclear incident objectives to name a few.

ICS applications and users have steadily increased since the system's original development. The FIRESCOPE program made the transition into a

national program called the National Interagency Incident Management System (NIIMS). Now the National Incident Management System (NIMS) is the standard being used by all agencies to stabilize, manage, and account for resources during all disasters.

Figure I-1 is an example of various agencies working together under the Incident Command System.

STUDENT REQUIREMENT

The I-100 course is designed to help you learn the principles of the Incident Command System and to briefly acquaint you with the basic ICS structure and terminology. It is intended for personnel assigned to an incident or event who have a minimum requirement for understanding ICS.

It will provide you, the student with enough information about the Incident Command System to enable you to work in a support role at an incident or event.

As a student in the New York State Scene Support Operations and Firefighter I course you will be assigned to complete the I-100 course. This will give you better insight into how emergency services are managed in your own department, as well as others you may work with in the field.

This course is just the beginning in the ICS series. The Office of Fire Prevention and Control offers courses to further your career in the Command and Management series. Attending courses such as I-200, I-300, and I-400 will become very important as you climb your fire service career ladder.

Submitted by
Leslie J. Greenwood
Fire Protection Specialist

Figure I-1

SECTION II

HAZARDOUS MATERIALS

OUTLINE

- NFPA 472
- 4.2.1 Detecting the Presence of Hazardous Materials
- 4.4.1 Initiating Protective Actions
- 5.2.1 Surveying the Hazardous Materials Incidents
- 5.2.2 Collecting Hazard & Response Information
- 5.2.3 Predicting the Behavior of a Material & Container
- 5.2.4 Estimating the Potential Harm
- 5.3.1 Describing Response Objectives for HazMat Incidents
- 5.3.4 Identifying Emergency Decontamination Procedures
- 5.4.3 Using Personal Protective Equipment
- 5.4.4 Performing Defensive Control Actions
- 5.5.1 Evaluating the Status of Defensive Actions
- 5.5.2 Communicating the Status of the Planned Response

NFPA 472

The information contained within these pages provides an additional resource for ensuring safety in the identification and response to hazardous materials. This information references selected competencies in NFPA 472 *Standard for Professional Competence of Responders to Hazardous Materials Incidents,* 2002 Edition, and should be utilized as a supplement to Chapters 24–30 in *Firefighter's Handbook: Essentials of Firefighting & Emergency Response, Second Edition.*

4.2.1 Detecting the Presence of Hazardous Materials

Selected Competencies

4.2.1 (g) (11)

Identify examples of clues (other than occupancy/location, container shape, markings/colors, placards/labels, MSDS, and shipping papers) that use the sense of sight, sound, and odor to indicate hazardous materials.

Sometimes it's fairly obvious when there are hazardous materials present. If you saw the paint bubbling and melting off a container, or a gas vapor cloud, this would be an instant signal to find out more information before proceeding. Here are some examples of clues that use your normal senses. There are some *serious* limitations involved with identifying hazardous materials in this manner. If you are close enough to see or smell a material, you may have endangered yourself and be at risk of injury. Touching a material also could cause injury, and tasting is not a recommended method of identification.

(a) Sight
  1 Visible corrosive actions
  2 Chemical reactions
  3 Pooling liquids
  4 Condensation lines on pressure tanks
  5 Injured victims or casualties
  6 Fire or vapor cloud

(b) Sound—hissing of pressure releases
(c) Odor
    1 Gas leaks
    2 Fire or vapor cloud

4.2.1 (g) (14)

Describe the difference between a chemical and a biological incident.

The main difference between a chemical and a biological agent attack is the time that it takes for signs and symptoms to become evident. With a chemical agent, the signs and symptoms take only minutes to hours to became evident, but with a biological agent, the signs and symptoms usually take anywhere from days to weeks to become evident.

(a) Onset of medical symptoms
    1 Chemical—onset of symptoms from minutes to hours
    2 Biological—onset of symptoms from days to weeks

4.2.1 (g) (16)

Identify at least four indicators of possible criminal or terrorist activity involving biological agents.

Not all HAZMAT incidents are caused by criminal or terrorists activity. If you respond to a leak in a laboratory, it's probably just that. Oftentimes, it is simply a result of an employee who had an accident while working, causing a spill or leak. On the other hand, if there's a report of a barrel leaking and causing a vapor cloud inside a shopping mall, that's far from normal. Common sense and judgment are required to determine what's normal and what's out of place. If you have suspicions, communicate them during the notification process.

(a) Unexplained, sudden onset illness or death
(b) Health care facilities reporting large numbers of sick people with the same symptoms
(c) Unscheduled sprayings, especially at night
(d) Abandoned spray devices

4.4.1 Initiating Protective Actions Selected Competencies

4.4.1 (3) (a)

Identify the precautions necessary when providing emergency medical care to victims of hazardous material incidents.

Encountering people who require medical attention at hazardous materials incidents is common. As a first responder, your first instinct may be to rush up and provide that help. That instinct could get you into trouble. Consider first that the victim may be contaminated, and measures must be taken to decontaminate them before it's possible to provide medical care. Awareness level responders typically do not wear respiratory or any other protective clothing and equipment, making it impossible to enter a hazardous atmosphere. Understand your own limitations so that you don't become a victim yourself.

(a) The victim may be contaminated; therefore, decontamination measures must be considered.
(b) Awareness level responders may not be wearing respiratory protection or any other personal protective clothing.
(c) Understanding your limitations will prevent you from becoming a victim.

4.4.1 (3)(b)

Identify typical ignition sources found at the scenes of hazardous materials incidents.

Sources of ignition often cause, or are present at hazardous materials incidents. You should take measures to eliminate these, especially if there are flammable vapors in the area. As an additional safety measure, eliminate the vapors by using a water fog to suppress or disperse them. Some typical ignition sources are:

(a) Open flames
(b) Smoking material's heat
(c) Cutting and welding operations
(d) Heated surfaces
(e) Frictional heat
(f) Radiant heat
(g) Static, electrical, and mechanical sparks
(h) Spontaneous ignition
    1 Heat-producing chemical reactions
    2 Pyrophoric materials

4.4.1 (3)(c)

Identify the ways hazardous materials are harmful to people, the environment, and property at hazardous materials incidents.

An awareness of these items can help you limit the amount of harm by removing the hazard, or removing the people.

(a) Thermal
(b) Etiologic
(c) Asphyxiation
(d) Mechanical
(e) Corrosive
(f) Poisonous
(g) Radiation
(h) Psychological

4.4.1 (3)(d)

Identify the general routes of entry for human exposure to hazardous materials for each hazard class.

Knowing the hazards of a material will give clues to the method that it may enter your body. Almost anything gives off at least some vapors that may be inhaled, although gases are much more likely to than liquids or solids. Liquids and solids may contact your skin and be further absorbed into your body. The responder must fully understand the potential hazards.

(a) Contact—skin surface hazard/damage (Classes 1 through 9)
(b) Absorption—includes entry through the eyes, skin and through punctures (Classes 1 through 9)
(c) Inhalation—respiratory function (Classes 1 through 9)
(d) Ingestion—mouth (Classes 1 through 9)

4.4.1 (4)(10)

First responders at the awareness level shall describe the difference between the isolation distances in the orange-bordered guide pages and the protective action distances in the green-bordered pages in the document.

Orange Pages: Comprises a total of 62 individual guides, presented in a two-page format. Each guide provides safety recommendations and emergency response information to protect yourself and the public. Each guide is designed to cover a group of materials that possess similar chemical and toxicological characteristics.

Green Pages: Contains a table that lists, by four-digit ID number, toxic inhalation hazard (TIH) materials, including chemical warfare agents, and water-reactive materials that produce toxic gases upon contact with water. The table provides two different types of recommended safe distances, which are "initial isolation distances" and "protective action distances."

(a) Green-bordered, or protective action distances are used for materials that present a toxic by inhalation hazard.
(b) Orange-bordered, or numbered guides used to protect from immediate hazards.

4.4.1 (11)

First responders at the awareness level shall identify the techniques used to isolate the hazard area and deny entry to unauthorized persons at hazardous materials incidents.

Everyone not directly involved in the incident should be kept away from the danger area. Some techniques to isolate the hazard area and deny entry are:

(a) Use a vehicle to block a road.
(b) Divert traffic.
(c) Erect barricades.
(d) Close doors and gates.
(e) Use the public address system.

4.4.1(12)

Identify at least four specific actions necessary when an incident is suspected to involve criminal or terrorist activity.

When responding to an incident that you suspect involved criminal or terrorist activities, you should do certain things to handle the situation. Always communicate your suspicion during the notification of the incident. Pass this information up the chain of command as soon as possible. Isolate potentially exposed people to protect them and others in the area. Document your initial observations, in case you are asked about them later.

(a) Take the appropriate actions to protect yourself and other responders.
(b) Communicate the suspicion during notification process.
(c) Isolate potentially exposed people or animals.
(d) Document the initial observation.
(e) Attempt to preserve evidence while performing operations
(f) Be alert for booby traps and/or explosive devices.
(g) Establish control zones and access control points.
(h) Prevent secondary contamination, including from handling patients.

5.2.1 Surveying the Hazardous Materials Incidents Selected Competencies

5.2.1.1 (F)

Given examples of the following radioactive material containers, the first responder at the operational level shall identify each container/package by type as follows:

Radioactive materials can be shipped in various types of containers/packages. CFR 49 covers transportation requirements and exceptions to placarding.

(a) Type A—Intended for materials with a higher concentration of radiation than allowed in excepted or industrial packages

(b) Type B—Intended for materials with a low concentration of radiation

(c) Industrial—Intended for materials with a low concentration of radiation

(d) Excepted—Intended for materials with an extremely low levels of radiation

(e) Strong, tight containers—Intended for materials with a low radioactivity, such as natural uranium and rubble from decommissioned nuclear reactors

5.2.1.2(A)(2)

Given examples of the following marked transport vehicles and their corresponding shipping papers, the first responder at the operational level shall identify the vehicle or tank identification marking, as follows:

(2) Intermodal equipment including tank containers

1 Metal certification plate with serial number

2 Shipper's identification number

3 Placards or labels

Intermodal tank containers transport bulk gases and liquids. They are enclosed in a sturdy metal supporting frame (either box type or beam type) built to international standards, which is typically 8 by 8 by 20 feet, although there are some 40-foot frames. They may be transported by highway, rail, or water.

Intermodal tank containers can be of three basic types: non-pressure, pressure, and specialized (including cryogenic portable tanks and tube modules). Some may be insulated, and some may be equipped with steam and/or electric heating.

Tank containers can carry a variety of hazardous and non-hazardous materials. Examples include food-grade commodities, liquid fertilizers, resins, anhydrous ammonia, liquefied petroleum gas (LPG), oxygen, helium, and nitrogen.

5.2.1.3 (B)

Given a pesticide label, the first responder at the operational level shall identify each of the following pieces of information, then match the piece of information to its significance in surveying the hazardous materials incident:

(1) Name of pesticide

(2) Signal word

(3) Pest control product (PCP) number (in Canada)

(4) Precautionary statement

(5) Hazard statement

(6) Active ingredient

The EPA has established the following requirements to be listed on all pesticide labels:

(a) Name of pesticide
- 1 Complete product name
- 2 Correct spelling
- 3 Ensures positive identification

(b) Signal word
- 1 Indicates relative hazard of product
- 2 **Caution**—might make you sick
- 3 **Warning**—will make you sick
- 4 **Poison/Danger** (always together)

(c) Pest control product (PCP) number (Canada), used to acquire additional information regarding a specific product.
- 1 EPA registration number (United States)
  - a Two- or three-section number

    12345 – 6789 – 11

    1 2 3
    - 1 Manufacturer
    - 2 Manufacturer sequence number
    - 3 Sub registration number (distributor's name)
- 2 Like the product name, ensures positive identification

(d) Precautionary statement
- 1 "Keep out of reach of children"
- 2 "Restricted use pesticide"

(e) Hazard statement
- 1 Physical and chemical hazards
- 2 On side panel

3 Lists any special flammability, explosion, or chemical hazards

(f) Active ingredient

1 Active ingredients—MUST be listed by chemical name

2 Inert ingredients—usually are not named

5.2.1.6

The first responder at the operational level shall identify at least three additional hazards that could be associated with an incident involving criminal or terrorist activity.

Not all HAZMAT incidents are caused by criminal or terrorists activity. If you respond to a leak in a laboratory, it's probably just that. Someone was working and had an accident causing a spill or leak. On the other hand, if there's a report of a barrel leaking and causing a vapor cloud inside a shopping mall, that's far from normal. Common sense and judgment are required to determine what's normal and what's out of place. If you have suspicions, communicate them during the notification process.

(a) Secondary events intended to incapacitate or delay emergency responders

(b) Armed resistance

(c) Use of weapons

(d) Booby traps

(e) Secondary contamination from handling patients

5.2.2 Collecting Hazard & Response Information Selected Competencies

5.2.2 (8)

Describe the properties and characteristics of the following:

(a) Alpha particles

(b) Beta particles

(c) Gamma rays

(d) Neutrons

Describe the properties and characteristics of the following:

(a) Alpha particles—slow moving, relatively heavy, short range of travel (3 inches), can be stopped by a sheet of paper

(b) Beta particles—high- speed particles, travel distance (7 feet), can be stopped by firefighter clothing and SCBA

(c) Gamma rays—travel great distances, can be shielded by several feet of concrete or a few inches of lead

(d) Neutrons—can be shielded with high hydrogen content materials, usually associated with operations of nuclear power plants or explosions

5.2.3 Predicting the Behavior of a Material & Container Selected Competencies

5.2.3 (1)(a)

Match the following chemical and physical properties with their significance and impact on the behavior of the container and/or its contents:

i. Boiling point (p.782–784)

ii. Chemical reactivity (p.799–800)

iii. Corrosivity (pH) (p.798-799)

iv. Flammable (explosive) range (LEL and UEL) (p.800)

v. Flash point (p.800)

vi. Ignition (auto-ignition) temperature (p.800)

vii. Physical state (solid, liquid, gas) (p.795)

viii. Specific gravity (p.798)

ix. Toxic products of combustion (p.800–801)

x. Vapor density (p.797)

xi. Vapor pressure (p.796–797)

xii. Water solubility (p.601)

xiii. Radiation (ionizing and non-ionizing)

(xiii) Radiation

1 Ionizing radiation—alpha, beta, gamma, neutron

2 Non-ionizing radiation—microwaves, radio waves, and visible light

5.2.3(1)(b)

Identify the differences between the following pairs of terms:

Exposure and hazard

3 Exposure

a Large quantities of hazardous material in concentrations that are not a hazard

b Small amounts of a hazardous material that is a very high hazard

Radioactive material exposure and contamination

1 Exposure—the magnitude of exposure relates to the duration of the exposure and the concentration of the radioactive material
2 Contamination—once contamination occurs, the victim will continue to be exposed to the radiation until the contamination is removed
3 Any exposure can go from external to internal by inhalation or ingestion

5.2.3(8)

Identify the health hazards associated with the following terms:

(c) Convulsant
(e) Sensitizer/allergen
(f) Alpha, beta, gamma, and neutron radiation

(c) Convulsant—material that causes convulsions
(e) Sensitizer/Allergen—material that through inhalation, ingestion, or skin absorption causes an allergic reaction
(f) Radiation—energy emitted by unstable (radioactive) atoms
1 Alpha (little or no hazard unless ingested)
2 Beta (may cause minor damage to exposed skin in small doses; the higher the dose the greater the damage)
3 Gamma (penetrates through human tissue and effects can be latent or acute)
4 Neutron (penetrates through human tissue and effects can be latent or acute)

5.2.3 (9)

Given the following types of warfare agents, identify the corresponding UN/DOT hazard class and division:

(a) Nerve agents (Class 6.1)
(b) Vesicants/blister agents (Class 6.1)
(c) Blood agents (Classes 6.1 & 2.3)
(d) Choking agents (Class 2.3)
(e) Irritants (Classes 6.1 & 2.2)
(f) Biological agents and toxins (Classes 6.1 & 6.2)

5.2.4 Estimating the Potential Harm

Selected Competencies

5.2.4 (6)

Describe the prioritization of emergency medical care and removal of victims from the hazard area relative to exposure and contamination concerns.

(a) START system
(b) Immediate, Delayed, Expectant system
(c) Various other triage methodologies

5.3.1 Describing Response Objectives for HazMat Incidents

Selected Competencies

5.3.1

Given an analysis of a hazardous materials problem and the exposures already lost, identify the steps for determining the number of exposures that could be saved by the first responder with the resources provided by the authority having jurisdiction and operating in a defensive fashion.

5.3.1 (1)

(1) Steps for determining the total number of exposures that could be saved
(a) Determine total number of exposures
(b) Determine number already lost
(c) Estimate the effectiveness of the chosen action options

5.3.1 (2)

(2) Steps for determining defensive response objectives
(a) Based on the current stage of the incident
(b) Strategic goals for now or for future events
(c) Decisions should focus on changing the stressor, the containment system, and the hazardous materials

5.3.1 (3)

(3) Assessing the risk to a responder for each of the hazard class in rescuing injured personnel at an incident.

(a) Class 1 risk—thermal, mechanical damage to personnel and property, etiological harm due to body fluids and asphyxiation
(b) Class 2 risk—thermal, asphyxiant, chemical, or mechanical based on material in container
(c) Class 3 risk—thermal, mechanical, and chemical
(d) Class 4 risk—thermal, mechanical, and chemical
(e) Class 5 risk—thermal, mechanical, and chemical
(f) Class 6 risk—thermal, and chemical
(g) Class 7 risk—thermal, radiological, and chemical
(h) Class 8 risk—thermal, mechanical, and chemical
(i) Class 9 risk—multitude of potential hazards based on specific material

5.3.4 Identifying Emergency Decontamination Procedures Selected Competencies

5.3.4 (3)

Identify the purpose of emergency decontamination procedures at hazardous materials incidents.

(a) Removes contaminates that pose an immediate threat to life
(b) Will not remove all contaminates

5.4.3 Using Personal Protective Equipment Selected Competencies

5.4.3 (1)

Identify the importance of the buddy system in implementing the planned defensive options.

(a) Accountability
(b) Safety
(c) No one works alone

5.4.3 (4)

Identify the symptoms of heat and cold stress.

(a) Heat stress
    1 Heat exhaustion
    2 Heat stroke
(b) Cold stress
    1 Hypothermia
    2 Frost bite

5.4.4 Performing Defensive Control Actions Selected Competencies

5.4.4 (2)(e)

Identify the characteristics and applicability of the following foams:

(e) High expansion
    1 Class A and B fires
    2 Total flooding of confined spaces
    3 Outdoor use is limited

5.5.1 Evaluating the Status of Defensive Actions Selected Competencies

5.5.1(2)

Describe the circumstances under which it would be prudent to withdraw from a hazardous materials incident.

(a) No way to mitigate the incident
(b) Situation is about to deteriorate

5.5.2 Communicating the Status of the Planned Response Selected Competencies

5.5.2 (2)

Identify the methods for immediate notification of the incident commander and other response personnel about critical emergency conditions at the incident.

(a) Immediate notification methods
(b) Established procedures for signaling
(c) Should not be delayed

SECTION III

NYS CONFINED SPACE RESCUE REGULATIONS & STANDARDS

OUTLINE

- Introduction to Confined Space
- The Problem
- Regulations and Standards
- Fire Department Confined Space Response Plans
- Confined Space Safety
- Case Histories

INTRODUCTION TO CONFINED SPACE

Virginia Beach, Virginia ... One worker and one firefighter killed during a rescue attempt from a ship hold.

Binghamton, New York ... One worker killed, 14 firefighters injured during a rescue attempt from an underground sewer pipe.

Elkridge, Maryland ... Two workers killed, one firefighter injured during a rescue attempt from an acid tank.

Phoenix, Arizona ... One worker and one firefighter killed, 14 other firefighters injured during a rescue attempt from an above ground storage tank.

Anchorage, Alaska ... One worker killed, nine firefighters injured during a rescue attempt from an aircraft fuel delivery truck.

Bristol, New Hampshire ... One worker and three firefighters killed during a rescue attempt from a 43 foot well.

Lancaster, Pennsylvania ... One firefighter and two paramedics killed during a rescue attempt from a septic tank.

Different cities, different fire departments and different rescues. All different but all sharing the same results—deaths and injuries occurred to would-be rescuers. If you look closely at these incidents you will see there is something in common. All of these deaths and injuries occurred while these departments were performing a rescue from a silent but deadly killer—a confined space.

THE PROBLEM

The US Department of Labor's Occupational Safety and Health Administration (OSHA) statistics show there are almost 240,000 establishments with approximately 4.8 million permit required confined spaces. These spaces must be entered on occasion to perform maintenance work and other necessary tasks. It is estimated that there are about 1.6 million workers who enter these spaces.

Confined spaces can contain many different types of hazards and accidents can and do happen. OSHA accident statistics show there are an average of 67 deaths per year in permit required confined spaces. Of particular interest is that some studies show up to 60 percent of these deaths are to would-be rescuers. These would-be rescuers consist of co-workers as well as firefighters, police officers and the like. In addition to the fatalities, there are an estimated 5900 lost workday accidents and 7000 non-lost workday accidents.

Because of these statistics, OSHA 29 CFR 1910.146—Permit Required Confined Spaces for General Industry was adopted and became effective

on April 15, 1993. It is estimated that the enforcement of this standard will reduce fatalities, injuries and illnesses by 85 percent.

REGULATIONS AND STANDARDS

The regulations pertaining to confined space entry and rescue are contained in OSHA 29 CFR 1910.146—Permit Required Confined Spaces for General Industry. While this regulation does not cover all industries, fire service response to confined space rescue is covered here. Some industries that are specifically excluded are agriculture, telecommunication, construction and shipyard employment.

Included in the standard are definitions, permit requirements, job descriptions and duties of the various functions including attendant, entrant and entry supervisor, rescue service requirements and training requirements. A copy of this standard is included at the end of this lesson.

Definitions

A **confined space** is a space that:

- is large enough and so configured so someone can bodily enter and work,
- has limited or restricted means for entry or exit; and
- is not designed for continuous occupancy.

Examples of confined spaces may include tanks, vessels, silos, storage bins, hoppers, vaults, manholes and pits (See Figure III-1).

A **permit required confined space** means a confined space that has one or more of the following characteristics:

- contains or has the potential to contain a hazardous atmosphere;
- contains a material that has the potential to engulf an entrant;
- has an internal configuration such that an entrant could be entrapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

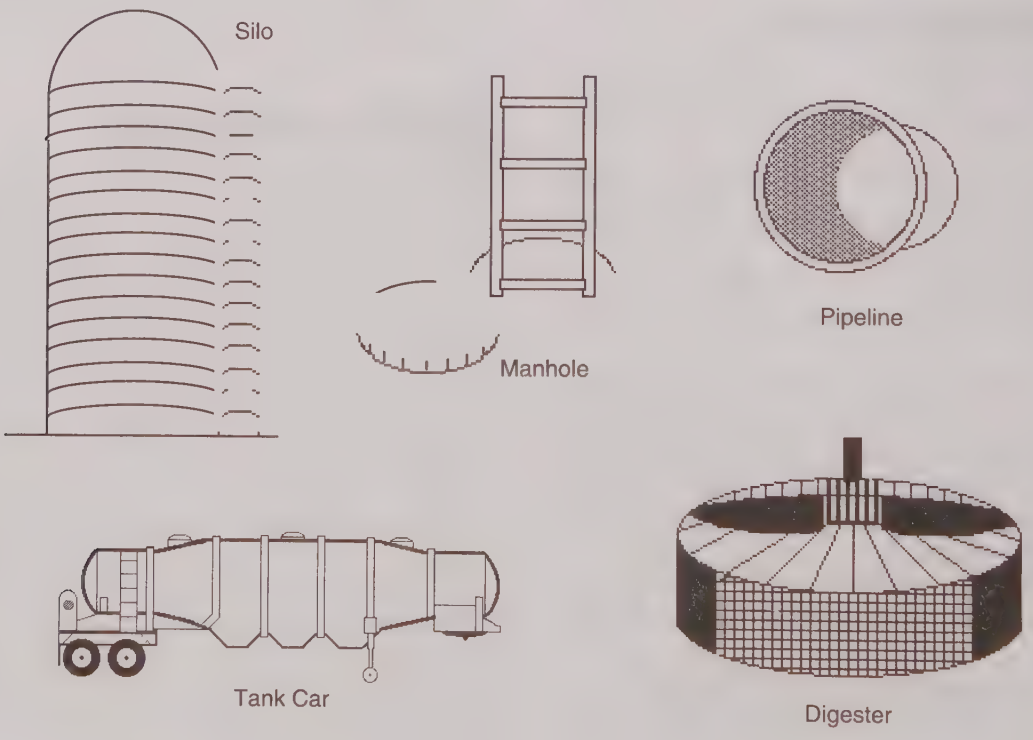

Figure III-1

- contains any other recognized serious safety or health hazard.

An **attendant** means an individual stationed outside the space who monitors the entrants and conditions within and outside the space.

An **entrant** is the person who passes through an opening into the space. Entry is considered to have occurred when any part of the entrant's body breaks the plane of an opening into the space.

An **entry supervisor** is the person in charge of the operation where persons enter confined spaces. This may be the incident commander or the rescue officer.

In a confined space rescue situation, all three of the above mentioned positions will be filled by rescue personnel. They may be referred to by different names but the fact remains that each one of these functions are vital to the safe completion of a rescue operation.

Rescue and Emergency Services

Paragraph K of the standard details the requirements for rescue and emergency services. All employers (except for those mentioned earlier) who have permit required confined spaces where workers enter are required to provide for rescue services. This may be accomplished with the use of an in-house or on-site team or with an agreement with an outside or off-site team. This is in addition to the requirement for non-entry retrieval systems that must be in place unless it creates a greater hazard to the entrant or would not be effective.

If fire departments are going to provide confined space rescue services, OSHA 1910.146 requires fire departments to train their personnel in the following areas:

- personal protective equipment and rescue equipment necessary for making rescues from confined spaces;
- any areas where duties are assigned so that the employee will have the necessary understanding, knowledge and skills for the safe performance of the rescue; and
- simulated rescues from actual or representative confined spaces.

More specifically this would include (but is not limited to) training in:

- fire department confined space response plans;
- personal protective equipment including SCBA and airline systems;
- atmosphere monitoring equipment;
- retrieval systems including tripods and rope systems;
- ventilation of confined spaces;
- First aid and CPR;
- space isolation (lock out/tag out) procedures; and
- proper removal techniques in a variety of rescue scenarios—actual hands on removal of mannequins or persons.

If a fire department agrees to perform rescue services for a specific site, they must be informed of the hazards and provided with access to the space for planning and training purposes. In addition, it is recommended that an agreement be reached with those responsible for the site with regards to the specific conditions under which the services will be provided.

Other OSHA Regulations Pertaining to Confined Space Rescue

The following OSHA standards can impact the ability of the fire department to provide rescue services depending on the level of response provided. Most of these have already affected the fire service so compliance should not, in most cases, be a major issue. Departments contemplating providing confined space rescue services will need to review these standards to ensure compliance.

OSHA 29 CFR 1910.133—Eye and Face Protection

OSHA 29 CFR 1910.134—Respiratory Protection (Includes requirements for physical examination and fit testing)

OSHA 29 CFR 1910.135—Occupational Head Protection

OSHA 29 CFR 1910.136—Occupational Foot Protection

OSHA 29 CFR 1910.120—Hazardous Waste Operations and Emergency Response

OSHA 29 CFR 1910.1030—Bloodborne Pathogens

OSHA 29 CFR 1910.147—Control of Hazardous Energy (Lockout/Tagout)

Additional Recommended Standards

The following recommended standards provide information to assist in properly selecting equipment and developing SOP's and programs. Some of these standards are referenced in the OSHA stan-

dards so they (or portions thereof) may need to be complied with.

American National Standards Institute (ANSI)

ANSI Z88.2-1980—Practices for Respirator Protection

ANSI Z88.2-1992—Respiratory Protection

ANSI Z117.1-1989—Safety Requirements for Confined Spaces

National Fire Protection Association (NFPA)

NFPA 1404—Fire Department Self-Contained Breathing Apparatus Program

NFPA 1500—Fire Department Occupational Safety and Health Program

NFPA 1521—Fire Department Safety Officer

NFPA 1581—Fire Department Infection Control Program

NFPA 1981—Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters

NFPA 1982—Personal Alert Safety Systems (PASS) for Fire Fighters

NFPA 1983—Fire Service Life Safety Rope

NFPA 328—Control of Flammable and Combustible Liquids and Gases in Manholes, Sewers and Similar Underground Structures

In addition, there may be other useful standards as indicated by the specific needs of the confined space site (i.e. NFPA standard for grain elevators etc.).

PESH FIRE SERVICE TRAINING CHECKLIST

See the checklist on page 23, following the Case History Worksheet.

FIRE DEPARTMENT CONFINED SPACE RESPONSE PLANS

If a fire department is going to respond to confined space incidents, it must have a plan in place that will provide the policies, procedures and guidance necessary for a safe and effective rescue. The plan should indicate the level of response the department will provide as well as basic guidance in areas, such as the duties of the various functions, training requirements, equipment, available resources and target sites and hazards.

Plan components

Identification of Confined Spaces

Before any consideration can be given to what level of response can be provided, it is necessary to determine the community's needs The first step in this process is identifying the confined spaces on district property as well as within the departments' response area. As the responsible authority for department property, the governing body must comply with the provisions of 1910.146 if there are permit required confined spaces on department property.

Potential locations for confined spaces in a response area include:

- Industrial, commercial and institutional facilities

  Examples include: manufacturing facilities, power plants, hospitals, schools and utilities
- Agriculture

  Examples include: silos, hoppers and pits
- Marine

  Example includes: hold of a ship
- Public Services

  Examples include: water systems, sewer systems including treatment facilities and storm sewer systems

Department Response Level(s)

After the confined spaces within the response area have been identified, the next step is deciding what is the appropriate level of response the department will provide. This is determined by evaluating the needs of the community, the ability of the department to provide the service and the available outside resources.

Aside from no response at all, there are four basic levels of response which a department may provide:

- Primary rescue team

  A fully trained and equipped team which will respond first to rescue incidents that occur.
- Backup response team

  A team that acts as a back-up to a primary response team, such as one provided by an industrial facility. This type of team may not carry all of the equipment necessary and instead rely on the facilities' equipment.

- First responder

  Where the organization utilizes mutual aid for rescue services but coordinates the response of other agencies. Medical and other non-rescue services may or may not be provided by the first responder organization.

- Support response

  No active role in rescue is provided and the only services provided are those that are as support to other agencies.

Personnel Requirements

As mentioned earlier, it is important to determine the department's ability to provide the necessary level of response. The first of two major areas to be examined is the department personnel's ability to meet the requirements of the expected level of response. The major areas of concern are:

- Personnel selection

  Physical requirements, mental attributes and enough people to volunteer for this duty. It is recommended, given the special stresses associated with this type of rescue, that this not be a forced assignment.

- Duty assignments

  Enough personnel must be available to fill the required positions for the chosen level of response.

- Training

  Depending on the level of response, the training requirements can be quite substantial. The assigned individuals must have the time and desire to obtain and maintain the necessary training.

- Outside resources

  Identifying these resources will help in determining what is available if needed. An example would be an industrial team that can respond out to the community which might eliminate the need for the department to have a primary level team.

Equipment Requirements

The second major area to be examined when determining whether the department is able to provide the expected level of response is the equipment requirements. Evaluating the spaces is required to determine such things as necessary monitoring and ventilation equipment, personal protective equipment and retrieval systems. When this has been accomplished, the ability of the department to purchase and maintain this equipment can play a major role in the decision making process.

Response Checklist

The final major component of the response plan is an emergency response checklist. This checklist provides for a systematic approach of evaluating the hazards present and the appropriate procedure to deal with the hazard. This checklist can also be used as a planning tool before an incident to assist in determining the level of response a department will provide to a facility or type of space.

The sample checklist on the next page is an example of what may be used to assist the decision making process. Listed along the left edge are a series of confined space hazards and across the top are control procedures and equipment. Where the corresponding rows and columns meet, a "•" indicates a suggested control procedure and equipment. A "o" indicates that entry must not be made until the explosive atmosphere is removed.

Of final concern when determining the appropriate response to the rescue situation is the concept of rescue vs. recovery. Rescue is defined as the saving of a live victim from a dangerous situation. Recovery is the removal of a victim's body that has been either legally pronounced dead or is obviously dead by reason of massive trauma or has been exposed for an extended time to an unsurvivable condition. In the end, we do not trade rescuers lives for victims lives nor do we risk rescuers lives to recover bodies.

CONFINED SPACE SAFETY

Confined Space Hazards

The atmosphere in a confined space may be extremely hazardous because of the lack of natural air movement. This characteristic of confined spaces can result in a) oxygen-deficient atmospheres, b) flammable atmospheres, and/or c) toxic atmospheres.

In addition to these atmospheric hazards, there are a number of physical hazards that the rescuer may encounter that will be a threat to their safety and well being. The identification and elimination of these hazards is a major component of a successful operation.

Oxygen-Deficient Atmospheres

An oxygen-deficient atmosphere has less than 19.5% available oxygen (02). Any atmosphere with less than 19.5% oxygen should *not* be entered without an approved self-contained breathing

New York State Department of State
Office of Fire Prevention and Control
Confined Space Rescue

On April 15, 1993, the OSHA Final Rule for Permit Required Confined Spaces (29 CFR 191 0.146) became effective and is being enforced by the New York State Department of Labor (DOL). In October 1993, DOL's Public Employee Safety and Health Bureau issued guidelines to insure compliance of local fire department programs.

This standard may have a substantial impact on the fire, rescue and emergency services depending on the adopted level of response. Before a fire department can determine the level of rescue service to be provide, they must understand the standard and its requirements; determine if the service can be provided in a timely manner; and maintain the necessary equipment and level of training.

Definition

A confined space is a space that:

- is large enough and configured so someone can bodily enter and work;
- has limited or restricted means for entry or exit; and
- is not designed for continuous occupancy.

Examples include: tanks, vessels, silos, storage bins, hoppers, vaults, manholes and pits.

A permit-required confined space has one or more of the following characteristics:

- contains or may potentially contain a hazardous atmosphere;
- contains a material with the potential to engulf an entrant;
- has an internal configuration such that an entrant could be entrapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- contains any other recognized serious safety or health hazard

Based on these definitions, many fire service response situations are considered confined space rescues. Most fire departments have confined spaces within their jurisdiction. Also, it does not matter whether a particular industry (such as agriculture) has been exempted from the regulation. Rescue services are required to follow the applicable sections of the standard any time entry is made into a space meeting the OSHA definition of a permit required confined space.

Training

If fire departments are providing confined space rescue services, under OSHA 1 9 10.146 personnel must be trained in the following areas:

- personal protective equipment and rescue equipment necessary for making confined space rescues;
- areas where duties are assigned so the employee will have the necessary understanding, knowledge and skills to safely perform the rescue; and
- simulated rescues from actual or representative confined spaces.

This training must include but is not limited to:

- fire department confined space response plans;
- personal protective equipment including SCBA and airline systems;
- atmosphere monitoring equipment;
- retrieval systems including tripods;
- rope systems;
- A-frames and gin poles;
- confined space ventilation;
- first aid and CPR;
- lock out/ tag out procedures; and
- proper removal techniques in a variety of rescue scenarios (actual hands on removal of dummies, manikins or persons).

If your fire department is contacted by private industry or a municipal government to be the rescue service for their confined space entry program, give careful consideration to the impact on your department. Ask these questions:

- Can we guarantee trained personnel will be available when needed?
- If we cannot commit personnel to the site, can we ensure response within a reasonable time?
- Do we have personnel who have the time to train at the specific sites or in representative spaces?

apparatus (SCBA) or Supplied Air Respirator (SAR) with an escape bottle.

The oxygen level in a confined space can decrease because of work being done, such as welding, cutting, or brazing; or, it can be decreased by certain chemical reactions (rusting) or through bacterial action (fermentation).

The oxygen level is also decreased if oxygen is displaced by another gas, such as carbon dioxide or nitrogen. Total displacement of oxygen by another gas, such as carbon dioxide, will result in unconsciousness, followed by death.

Flammable Atmospheres

Two things make an atmosphere flammable: 1) the oxygen in air; and 2) a flammable gas, vapor, or dust in the proper mixture. Different gases have different flammable ranges. If a source of ignition (e.g., a sparking or electrical tool) is introduced into a space containing a flammable atmosphere, an explosion will result.

An oxygen-enriched atmosphere (above 23.5%) will cause flammable materials, such as clothing and hair, to burn violently when ignited. Therefore, *never use pure oxygen to ventilate a confined space*. Ventilate with normal air.

Toxic Atmospheres

Most substances (liquids, vapors, gases, mists, solid materials, and dusts) should be considered hazardous in a confined space. Toxic substances can come from the product stored in the space or the product can be absorbed into the walls and give off toxic gases when removed. Toxic vapors can also be given off when cleaning out the residue of a stored product. For example, removal of sludge from a tank of decomposed material can give off deadly hydrogen sulfide gas.

Work being performed in a confined space such as welding, cutting, brazing, painting, scraping, sanding, and degreasing, can also generate vapors. For example, cleaning solvents are used in many industries for cleaning/degreasing. The vapors from these solvents are very toxic in a confined space.

Atmospheric conditions in areas adjacent to the confined space can also enter and accumulate in a confined space, contaminating the area.

General/Physical Hazards

In addition to the areas discussed above, evaluation of a confined space should consider the following potential hazards:

Temperature Extremes: Extremely hot or cold temperatures can present problems for workers. For example, if the space has been steamed, it should be allowed to cool before any entry is made. Also, some confined spaces can be very cold, so insulating clothing may need to be worn.

Engulfment Hazards: Loose, granular material stored in bins and hoppers, such as grain, sand, coal, or similar material, can engulf and suffocate a worker. The loose material can form a crust or bridge over in a bin and break loose under the weight of a worker.

Noise: Noise within a confined space can be amplified because of the design and acoustic properties of the space. Excessive noise can not only damage hearing, but can also affect communication, such as causing a shouted warning to go unheard.

Slick/Wet Surfaces: Slips and falls can occur on a wet surface causing injury or death to workers. Also, a wet surface will increase the likelihood of and the effect of electric shock in areas where electrical circuits, equipment, and tools are used.

Falling Objects: Workers in confined spaces should be mindful of the possibility of falling objects, particularly in spaces which have topside openings for entry, and where work is being done above the worker.

Released Energy or Materials: The accidental release of energy and materials includes electricity, steam, compressed gasses, liquids, hydraulic fluids and flowable solids. Examples include the startup of machinery in the space, machinery outside the space which may introduce a hazard into the space or the opening of valves which may introduce a hazard. Control of the accidental release of materials is a very important step in any confined space rescue operation.

Space Isolation

The purpose of space isolation is to prevent hazards from entering the space while people are inside. These hazards can take many forms and are introduced in a number of ways. There are a number of hazards that can present a problem in confined space situations. These include liquids, gasses, solids, mechanical and electrical. Therefore, there needs to be different methods available to prevent these hazards from entering the space.

In most cases, the space should be isolated before your arrival. These techniques are common practice in situations where permits are in effect. In any case, the space must be isolated, and you must be sure of this, before committing personnel into the space.

In the extremely rare situations that it is not possible to isolate the space (such as sewer systems), every precaution should be taken to monitor for the

unexpected release of a hazard into the space. An example would be to station personnel at various points of the sewer system to monitor for a rise in liquid level or introduction of a hazardous material (such as an industrial discharge).

OSHA Isolation Procedure

The Occupational Safety and Health Administration has developed a six step procedure for the ensuring that a space is properly isolated for safe entry. These steps are:

1) Prepare for shutdown. Determine energy type and control methods.
2) Shut down the equipment. Use the normal stopping procedure if possible.
3) Isolate the equipment. This includes ALL sources—both primary and secondary energy sources.
4) Apply lockout, tagout and/or bleed/block devices.
5) Control stored energy. This includes bleeding off pressure in lines etc.
6) Verify isolation of equipment.

Methods of Space Isolation

Lockout/tagout is used for all types of hazards. Prevents valves or switches from being opened. Utilizes locks, chains, lockout hasps, circuit breaker lockouts, ball valve lockouts, valve covers, plug locks and warning tags. (See Figure III-2)

Bleed/block or blank/blind is used on piping that carries liquids, flowable solids and gasses. It utilizes blind flanges, removal of sections of pipe and bleeding materials from the piping and is sometimes used in combination with lockout/tagout. (See Figure III-3)

If it is not possible to lockout or bleed/block a line or device, a person should be stationed at the switches and/or valves to ensure that they are not turned on. The best policy in this situation is to use fire department personnel with a clear policy set on who can order that a line or device opened or turned on.

CASE HISTORIES

The case histories provided in this lesson were taken from actual incidents that have occurred. The information was obtained from case investigations conducted by the National Institute of Occupational Safety and Health (NIOSH).

Case History 1

The owner of a bulk petroleum storage facility discovered that a toluene storage tank (10 feet in

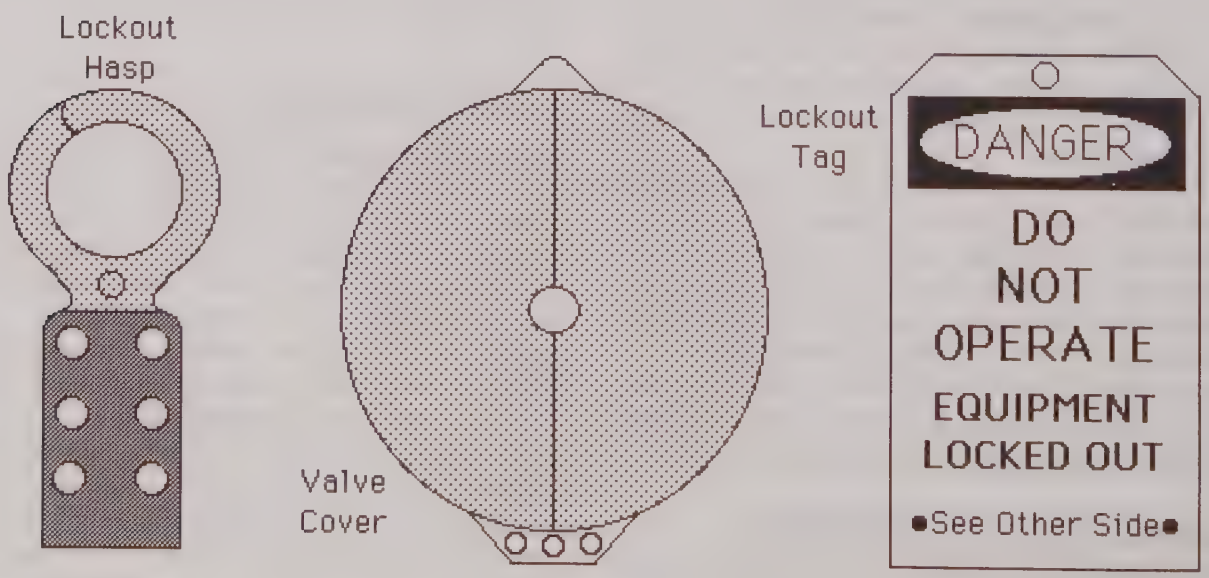

Figure III-2

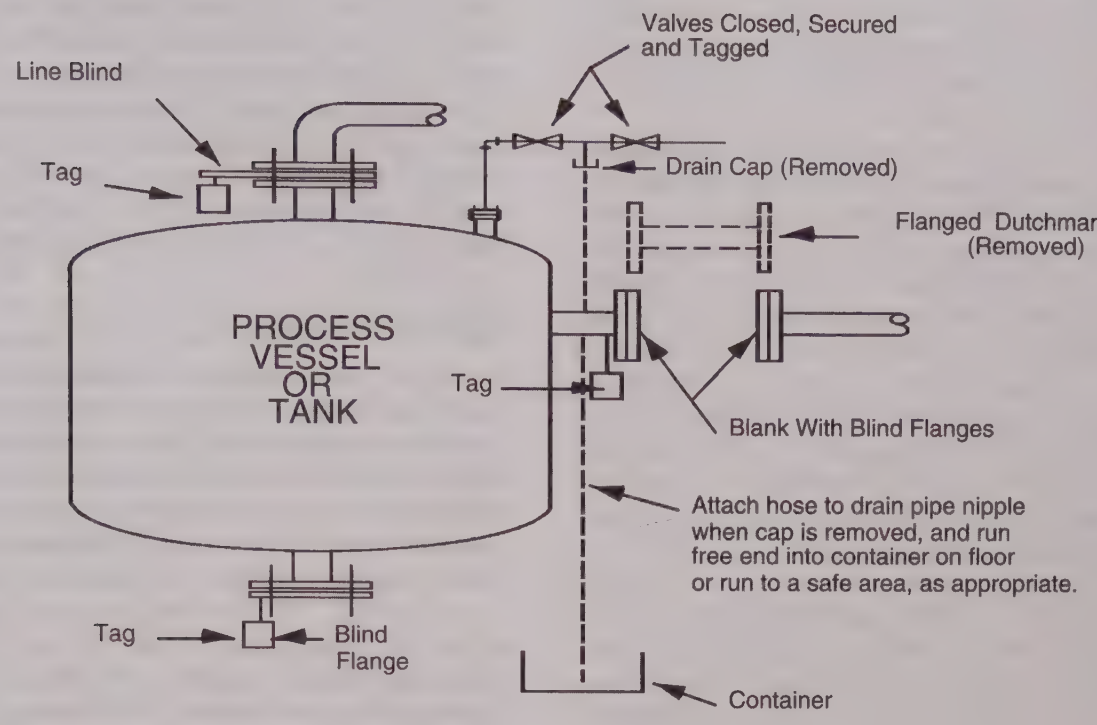
Valves Closed, Secured and Tagged
Line Blind
Tag
Drain Cap (Removed)
Flanged Dutchman (Removed)
PROCESS VESSEL OR TANK
Tag
Blank With Blind Flanges
Attach hose to drain pipe nipple when cap is removed, and run free end into container on floor or run to a safe area, as appropriate.
Tag
Blind Flange
Container

Figure III-3

diameter and 20 feet in height) was contaminated and would have to be drained and cleaned. The owner decided that, as long as the tank would be empty, he would have a cleanout portal installed at the bottom of the tank. The maintenance supervisor was directed to prepare the tank (this was to involve draining the tank, removing all of the sludge and ventilating the tank) so the contractor could begin work.

On the day of the incident, the supervisor and an unskilled laborer drained the tank, leaving about two to three inches of sludge and toluene in the bottom. The supervisor rented an SCBA and instructed the laborer in its use and in the procedure they intended to follow. Since a ladder would not fit into the 16 inch diameter hole, a knotted one quarter inch rope would be used for entry and exiting.

Immediately prior to the incident, the laborer entered the tank while the supervisors' back was turned while getting the SCBA. With the laborer standing in the bottom of the tank, the supervisor called to him (whom he could see) to come out of the tank but there was no response other than mumbling. The SCBA was lowered into the tank but there was still no response from the laborer. The laborer fell to his knees, then to his back and continued mumbling.

At this point, the police department was called who in turn notified the fire department. The fire department response included a rescue and hazardous materials team. Arrival was approximately 10 minutes after the initial notification. Because the hole at the tank's top was not big enough to enter with full rescue gear, including SCBA, it was decided to cut through the side of the tank with a saw to gain access to the victim.

Because of the explosive nature of the tank's contents, hose lines were directed at both the exterior and interior cuts to prevent sparks from providing an ignition source. Sometime during the final cutting stages, a decision was made to remove the hose line from the top of the tank (providing the interior spray). At the same time, the exterior spray was moved to extinguish a flammable liquid burning on the ground which was ignited by sparks from the saw. At this moment the tank exploded, killing one firefighter. The victim in the tank was presumed already dead at the time of the explosion.

Case History 2

A new sewer line several thousand feet long was being constructed of 66 inch ID pipe because of the construction of an interstate highway. A sewer

bypass was provided in order to keep the line in service during the construction. The new pipe was sandbagged at the connection point to keep sewage out of the new line. During the month these sandbags were in place, sewage seeped past the bags and extended almost 500 feet into the new line.

In order to grout the new line, the sewage had to be stopped and removed. A steel plug replaced the sandbag dike and a gasoline engine driven pump was placed upstream from the plug so the sewage could be removed. A worker had to enter the pipe approximately 1200 feet from the pump, walk to the pump, fuel the engine, start it and go back the 1200 feet to exit. This procedure was performed on a 3 day cycle but because it was not removing the sewage quickly enough, the cycle was increased to 3 times per day. No atmospheric testing was performed at any time prior to entry and no mechanical ventilation was provided to remove air contaminates.

On the morning of the incident, 2 workers entered the pipe and performed the pumping procedure. Later in the day, the procedure needed to be repeated. However, the manhole they had been entering was now covered over and framed in preparation for having concrete poured the following day. The 2 workers now had to enter the pipe about 3000 feet from the pump. After they had proceeded about 750 feet past the manhole they had entered earlier but was now closed, they came to a board that was used to mark the waterline. While one of the workers removed the board, the other proceeded to the pump.

There was a haze in the pipe. The worker that stayed behind heard the other worker try to start the pump and then heard him say he felt dizzy. The worker at the pump started to leave but stumbled and fell. By the time the second worker reached him, he was down and unresponsive so worker #2 tried to carry him out. This was not possible so worker #2 left worker #1 propped up in the pipe and walked, crawled and stumbled the 3000 feet to the outside.

At this time, 7 workers went into the pipe in an attempt to rescue the downed worker. At the same time a state inspector, who was on the site, drove to the manhole that was covered over for the concrete work, removed the plywood, and proceeded toward the downed worker. Some of the workers managed to reach the victim but were unable to remove him. The inspector did not exit the pipe.

When the fire department arrived, they entered the pipe with SCBA and traveled approximately 500 to 600 feet down the pipe to where both victims (the worker and inspector) were located. As their air supply decreased, the firefighters placed an SCBA on the victim (state inspector) who was still breathing, and resorted to buddy breathing to exit. Both victims were removed and pronounced dead at the scene.

As a result of the rescue effort, 30 firefighters and 8 construction workers were treated for CO intoxication and/or exhaustion. Combustible gas, oxygen and carbon monoxide measurements were taken 22 hours later at the incident site. The oxygen level was 19 percent and the concentration of CO was 600 PPM. It was estimated that the CO level next to the pump at the time of the incident was 2000 PPM.

Case History 3

As part of an annual maintenance program, an electroplating company employee entered a zinc cyanide holding tank in order to clean it. This tank (which measured 4 feet wide by 5 feet high) was one of a series of open-top steel tanks that form two parallel lines of tanks. A 5 foot wide removable metal grating walkway was provided between the rows of tanks. This walkway is approximately 8 feet off of the drainage pit floor. The only ventilation this room receives is from two exhaust fans on the ceiling about 20 feet above the tanks, 5 windows (which were closed at the time of the incident) and 1 open door.

One day prior to the incident, an industrial cleaning and waste hauling company had completed pumping out the tanks. However, the zinc cyanide holding tank where the incident occurred still contained about 2 inches of zinc cyanide sludge in the bottom. During the night shift, the employees were cleaning and rinsing the tanks in preparation of changing from the cyanide process to an acid plating process. During the cleaning process, the metal grating walkway was removed. Because the top end of the holding tank was now 8 feet off the floor, a ladder was used to reach the tank's top.

In the cleaning procedure that had never been attempted before, the victim pumped 1 to 2 gallons of 1% muriatic acid solution into the zinc cyanide holding tank and then climbed into the tank. The tank had not been tested or ventilated prior to entry. The victim was not wearing any respiratory protection and the only PPE he was wearing were gloves, boots and an apron. Within a few minutes, hydrogen cyanide vapor formed in the tank due to a chemical reaction between the muriatic acid and zinc cyanide.

About 4 minutes after he entered the tank, co-workers observed the victim trying to climb out but then fall back into the tank. Four co-workers entered the tank in an attempt to rescue the victim. They were wearing varying amounts of PPE but no respiratory protective equipment. They all collapsed inside the tank. Other co-workers, seeing these workers collapse, made varying rescue attempts.

One person (without respiratory protection) managed to remove one of the four co-workers (who was bent over the top of the tank with his head down inside) and administered CPR. By this time, most of the other workers who entered the room could not even get close to the tank because of the hydrogen cyanide vapors. In all, the initial victim and four co-workers were to die from asphyxiation due to overexposure to hydrogen cyanide vapor.

The city police, state police and fire department were notified. Personnel from these departments arrived within approximately 15 minutes and began removing workers from the holding tank. The firefighters were wearing standard turnout gear with SCBA and the police had no PPE or respiratory protection. The rescue effort was initially hampered because the responders were not aware that hydrogen cyanide vapor was involved. After learning from plant employees that acids and zinc cyanide were used, they suspected that hydrogen cyanide was involved.

The hydrogen cyanide vapor permeated the exposed skin and the "leather" turnout gear when the victims were removed from the tank. As a result, 4 police officers and 13 firefighters received toxic exposure and the turnout gear became contaminated. In addition, 12 workers required medical attention as well as 1 medical examiner.

One additional complication in this incident was an uncertainty between the responding agencies as to who should take command of the rescue effort, including administering emergency medical care and securing the contaminated area from unauthorized entry. This disorganization continued for nearly 2 hours before the premises were finally sealed off.

Case History 4

Four firefighters responded to a request to remove the remains of a dead animal from a 33 foot deep well. The concrete well opening measured 18 by 22 inches. The well shaft (from ground level down to a depth of 15 feet) was constructed of concrete and measured 5 feet by 7 feet. Below the 15 foot level, the well was an earthen hole 5 feet in diameter. To remove the remains of the animal, it was decided to remove about 12 feet of water from the well. An attempt was made to remove the water with 2 different fire trucks but neither was able to draft water up almost 30 feet. Because of this, it was decided to use a 9 horsepower gasoline engine powered pump.

One firefighter climbed down into the well on an aluminum ladder and built a wooden platform at the 15 foot level. A second firefighter entered the well to help position the pump that was lowered to the platform. The two firefighters started the engine but were unable to prime the pump. Within a few minutes, the first firefighter became dizzy and exited the well. The second firefighter stayed in the well and became unconscious.

In a rescue attempt the first firefighter climbed back into the well, turned off the engine and then collapsed unconscious over the engine. By this time, the engine had run for approximately 8 to 9 minutes. Within minutes, several other firefighters responding to radio emergency calls arrived at the scene.

The second firefighter apparently then fell off the platform face down into the water, which was 6 feet below the platform. At this time, a third firefighter entered the well but was unable to lift the first firefighter so he climbed back out. A fourth firefighter climbed into the well with one end of a rope and tied it around the first firefighter's torso. He then collapsed and fell face down into the water.

By this time, additional help arrived and they attempted to pull the first firefighter by the rope that was attached. They were unsuccessful. A fifth firefighter entered the well and placed the first firefighter on his shoulder and hoisted him out of the well. CPR was begun and the first firefighter regained consciousness. Up until this time, none of the firefighters entering the well wore any type of respiratory protection.

A sixth firefighter donned an SCBA and started down into the well, followed by the fifth firefighter (who was not wearing respiratory protection). Within a minute, the fifth and sixth firefighters came out of the well. The sixth firefighter complained he was having difficulty wearing the SCBA because of the cramped conditions and the fifth firefighter complained of dizziness. The sixth firefighter then re-entered the well with a rope and without the SCBA. Upon reaching the platform, he yelled that he needed help.

A seventh firefighter, who was not wearing any respiratory protection, climbed down to the platform and observed the second, fourth and now the sixth firefighters all floating face down in the water.

In all, four more rescuers entered the well to assist in the rescue attempt. Two wore SCBA and two did not. By the time the final victim was removed, three hours had elapsed since the first rescue attempt on the second firefighter.

The cause of death of the second and sixth firefighters was carbon monoxide inhalation. The cause of death of the fourth fire fighter was drowning with loss of function due to carbon monoxide inhalation.

CASE HISTORY WORKSHEET

The confined space entry

What factors may have contributed to the confined space fatality?

Based on the above factors, what recommendations would you make to reduce the risk of an incident like this happening again?

The rescue effort

What factors may have contributed to the rescue effort fatality and injuries?

Based on the above factors, what recommendations would you make to reduce the risk of an incident like this from happening again?

PESH FIRE SERVICE TRAINING CHECKLIST

Done	Confined Space 1910.146	Need to Do
	1910.146(c)(1) The employer shall evaluate the workplace to determine if any spaces are permit-required confined spaces. NOTE: Proper application of the decision flow chart in Appendix A to section 1910.146 would facilitate compliance with this requirement.	
	1910.146(c)(2) If the workplace contains permit spaces, the employer shall inform exposed employees, by posting danger signs or by any other equally effective means, of the existence and location of and the danger posed by the permit spaces.	
	1910.146(c)(3) If the employer decides that its employees will NOT enter permit spaces, the employer shall take effective measures to prevent its employees from entering the permit spaces and shall comply with paragraphs (c)(1), (c)(2), (c)(6), and (c)(8) of this section.	
	1910.146(c)(6) When there are changes in the use or configuration of a nonpermit confined space that might increase the hazards to entrants, the employer shall reevaluate that space and, if necessary, reclassify it as a permit-required confined space.	
	1910.146(c)(8) When an employer (host employer) arranges to have employees of another employer (contractor) perform work that involves permit space entry, the host employer shall: 1. Inform the contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements of this section; 2. Apprise the contractor of the elements, including the hazards identified and the host employer's experience with the space, that make the space in question a permit space; 3. Apprise the contractor of any precautions or procedures that the host employer has implemented for the protection of employees in or near permit spaces where contractor personnel will be working; 4. Coordinate entry operations with the contractor, when both host employer personnel and contract or personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and 5. Debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations.	
	1910.146(c)(4) If the employer decides that its employees WILL enter permit spaces, the employer shall develop and implement a written permit space program that complies with this section. The written program shall be available for inspection by employees and their authorized representatives.	

Done	Confined Space 1910.146	Need to Do
	1910.146(g)(1) Employer shall provide training so that all employees whose work is regulated by this section acquire the understanding, knowledge, and skills necessary for the safe performance of the duties assigned under this section. (g)(2) Training shall be provided to each employee (g)(2)(i) Before the employee is first assigned duties under this section (g)(2)(ii) Before there is a change in assigned duties (g)(2)(iii) Whenever there is a change in the permit space operations that present a hazard about which the employee has not been previously trained.	
	1910.146(g)(2)(iv) Whenever the employer has reason to believe either that there are deviations from the permit space entry procedures required by paragraph (d)(3) of this section or that there are inadequacies in the employee's knowledge or use of these procedures.	
	1910.146(g)(3) The training shall establish employee proficiency in the duties required by this section and shall introduce new or revised procedures, as necessary, for compliance with this section.	
	1910.146(g)(4) The employer shall certify that the training required by paragraphs (g)(1) through (g)(3) of this section has been accomplished. The certification shall contain each employee's name, the signatures or initials of the trainers, and the dates of training. The certification shall be available for inspection by employees and their authorized representatives.	
	1910.146(h) Duties of authorized entrants.	
	1910.146(i) Duties of attendants.	
	1910.146(j) Duties of entry supervisors.	
	1910.146(k) Rescue and emergency services.	
	1910.146(k)(1) An employer who designates rescue and emergency services, pursuant to paragraph (d)(9) of this section, shall:	
	1910.146(k)(1)(i) Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner, considering the hazard(s) identified; *Note to paragraph (k)(l)(i):* What will be considered timely will vary according to the specific hazards involved in each entry. For example, §§1910.134, Respiratory Protection, requires that employers provide a standby person or persons capable of immediate action to rescue employee(s) wearing respiratory protection while in work areas defined as IDLH atmospheres.	
	1910.146(k)(1)(ii) Evaluate a prospective rescue service's ability, in terms of proficiency with rescue-related tasks and equipment, to function appropriately while rescuing entrants from the particular permit space or types of permit spaces identified;	

Done	Confined Space 1910.146	Need to Do
	1910.146(k)(1)(iii) Select a rescue team or service from those evaluated that:	
	1910.146(k)(1)(iii)(A) Has the capability to reach the victim(s) within a time frame that is appropriate for the permit space hazard(s) identified;	
	1910.146(k)(1)(iii)(B) Is equipped for and proficient in performing the needed rescue services;	
	1910.146(k)(1)(iv) Inform each rescue team or service of the hazards they may confront when called on to perform rescue at the site; and	
	1910.146(k)(1)(v) Provide the rescue team or service selected with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations. *Note to paragraph (k)(1):* Non-mandatory Appendix F contains examples of criteria which employers can use in evaluating prospective rescuers as required by paragraph (k)(l) of this section.	
	1910.146(k)(2) An employer whose employees have been designated to provide permit space rescue and emergency services shall take the following measures:	
	1910.146(k)(2)(i) Provide affected employees with the personal protective equipment (PPE) needed to conduct permit space rescues safely and train affected employees so they are proficient in the use of that PPE, at no cost to those employees;	
	1910.146(k)(2)(ii) Train affected employees to perform assigned rescue duties. The employer must ensure that such employees successfully complete the training required to establish proficiency as an authorized entrant, as provided by paragraphs (g) and (h) of this section;	
	1910.146(k)(2)(iii) Train affected employees in basic first-aid and cardiopulmonary resuscitation (CPR). The employer shall ensure that at least one member of the rescue team or service holding a current certification in first aid and CPR is available; and	
	1910.146(k)(2)(iv) Ensure that affected employees practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, manikins, or actual persons from the actual permit spaces or from representative permit spaces. Representative permit spaces shall, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed.	
	1910.146(k)(3) To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements.	

Done	Confined Space 1910.146	Need to Do
	1910.146(k)(3)(i) Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at the center of the entrant's back near shoulder level, above the entrant's head, or at another point which the employer can establish presents a profile small enough for the successful removal of the entrant. Wristlets may be used in lieu of the chest or full body harness if the employer can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.	
	1910.146(k)(3)(ii) The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical type permit spaces more than 5 feet (1.52 m) deep	
	1910.146(k)(4) If an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or other similar written information is required to be kept at the worksite, that MSDS or written information shall be made available to the medical facility treating the exposed entrant.	

SECTION IV

NYS OFPC FIREFIGHTER-I ADDITIONAL SKILLS

OUTLINE

- 7-3 SCBA Emergencies Skill
- 7-4 Wall Breach/Swim/Dive Maneuver
- 7-5 Low-Profile Maneuver
- 7-6 Full Escape Maneuver
- 7-7 Air Consumption Exercises
- 7-8 Maze Skills
- 23-1 Survival Skills: Follow Hose Line
- 23-2 Survival Skills: First Floor Window Bailout
- 23-3 Survival Skills: Exit Location
- 23-4 Survival Skills: Calling the Mayday #1
- 23-5 Survival Skills: Calling the Mayday #2
- 26-1 Identify Chemical Hazards Using the NAERG
- 28-1 Perform an Emergency Decontamination of a Simulated Victim
- 29-1 Using Air Monitoring Device to Determine the Presence of CO Gas

7-3 SCBA Emergencies Skill

This skill will prepare the student to survive a failure of the SCBA. There are 6 individual SCBA emergency scenarios—cracked face piece lens, severed low pressure line, regulator failure, total regulator failure, severed high pressure line, and filter breathing.

7-4 Wall Breach/Swim/Dive Maneuver

The swim-dive maneuver is designed to build the confidence of the student while demonstrating their ability to escape from an untenable area of a building fire by breaching a wall to survive. Without removing their SCBA the student will manipulate their body position to proceed thru a common studded wall opening of 16 inches on center.

7-5 Low-Profile Maneuver

In the event that the student cannot successfully escape through a studded wall using the swim-dive method, the student will demonstrate the low profile maneuver. This maneuver is described in the Firefighter's Handbook. The student will loosen the SCBA back plate straps and slide the SCBA under their arm to reduce their profile and escape thru the studded wall.

7-6 Full Escape Maneuver

As a last resort, if the firefighter absolutely cannot escape thru a small opening, the SCBA back plate will be removed while maintaining a face piece seal. This technique will enhance the student's ability to don and doff their SCBA in a stressful environment, as well as give them a survival tool.

7-7 Air Consumption Exercises

During this evolution the student will gain needed experience in using the SCBA, as well as learning their limitations in full protective clothing and SCBA. The focus of this evolution is for the student to begin to develop the ability to conserve air while walking thru an obstacle course.

7-8 Maze Skills

A series of obstacles will be encountered in the maze that simulates conditions found in incidents that have caused firefighter fatalities or injuries. The student will be coached thru the obstacles with their vision obscured. The students will be required to use several of the learned SCBA confidence skills in order to travel thru the maze and conserve enough air to reach the end of the evolution.

23-1 Survival Skills: Follow Hose Line

The student, placed in the middle of a room, while wearing complete PPE/SCBA with their face piece covered, shall locate a hose line and follow the hose line to the exterior in 60 seconds or less.

23-2 Survival Skills: First Floor Window Bailout

The student, given a hand tool, and wearing complete PPE/SCBA, shall simulate clearing glass from a first floor window for emergency exit, and then perform the emergency exit procedure. The student must demonstrate the ability to stay low in the window to avoid exiting gases and heat as they roll out of the window and brace themselves to create a controlled descent to the ground below.

23-3 Survival Skills: Exit Location

The firefighter placed in the middle of a room, while wearing PPE/SCBA with the face piece covered, shall perform a quick perimeter search for doors and windows and determine which may be used for emergency exit in 60 seconds or less.

23-4 Survival Skills: Calling the Mayday #1

The firefighter trainee, in full PPE/SCBA, shall demonstrate the proper procedures for using a radio to call a Mayday. This skill must be performed in FIVE different body positions using the left and right hand. The trainee shall accomplish this skill in 1 minute or less with 100% competency.

23-5 Survival Skills: Calling the Mayday #2

The firefighter trainee, in full PPE/SCBA, shall demonstrate the proper procedures for using a radio to call a Mayday when lost/trapped. The trainee shall accomplish this skill in 1 minute or less with 100% competency.

26-1 Identify Chemical Hazards Using NAERG

The student shall identify the correct chemical hazard and describe the appropriate action steps given an emergency response guidebook, placards, labels and/or container shape in a specific scenario. The student shall accomplish the exercise in 10 minutes with 100% competency.

28-1 Perform an Emergency Decontamination of a Simulated Victim

The student, wearing full PPE/SCBA, as part of an engine company shall demonstrate emergency decontamination procedures of a victim of a hazardous materials spill in preparation of the victim being transported by an ambulance. The student shall perform the skill in such a manner that he/she does not become exposed to the hazardous materials and the contamination of the environment is kept to a minimum.

29-1 Use Air Monitoring Device to Determine the Presence of CO Gas

The student, wearing full PPE/SCBA, as part of an engine company shall demonstrate the proper use of an air monitor to investigate a report of a CO Alarm activation with illness in the residence. This skill is to be performed as a Hazardous Materials First Responder Operations level of training.

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